CHAPTER 16

CALCULATING PIPE LENGTHS

Introduction   Pipe lengths are figured using the elevation differences
                 of the pipe and the roadway grade above it.

                 Three things are needed to figure the pipe length.
                 1.   The inlet and outlet elevations of the pipe.
                 2.   The profile grade of the roadway at the station of the
                        pipe.
                 3.   The typical cross section for the roadway.

                 A sample form to use in calculating the pipe length is
                 attached.

Example   A 24" CS pipe is to be placed under the fill at
                 station 12+25 is 563.15. The typical section is shown
                 below:
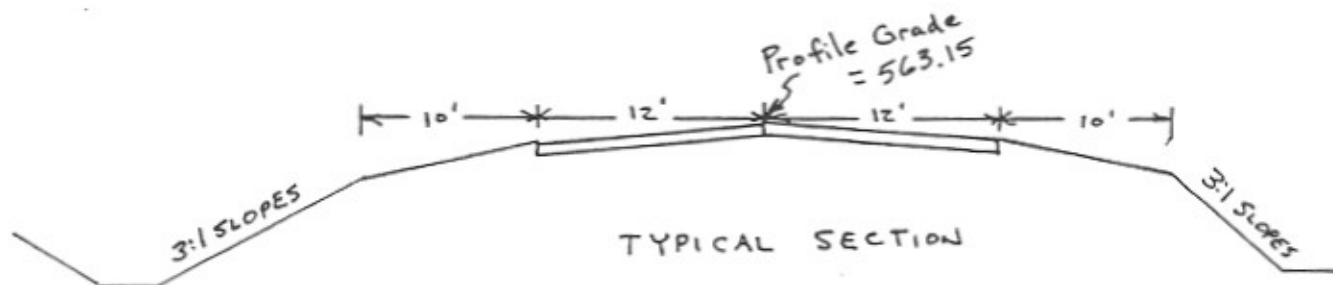
                 There is a 2 1/2" Crown in the pavement.
                 Shoulders slope at 1/2" per ft.
                 Side slopes are 3:1.

Step 1.   Fill in profile grade and determine shoulder elevation.
                 Mark left & right side of sheet.
                     2 1/2" Crown =2.5"/12" = 0.2083'= 0.21'
                     563.15 - 0.21 = 562.94 Shoulder Elevation
                     Place this elevation on sheet. See figure A.

Step 2.   Place the inlet and outlet elevations on the proper sides
                 of the sheet on the flowline elevation line (Inlet on the
                 left and outlet on the right.) Subtract this elevation
                 from the shoulder elevation to get the gross fill. See
                 sheet, figure B.

Step 3.   Deduct the diameter of the pipe from the gross fill to
                 get the net fill for each half of the roadway.
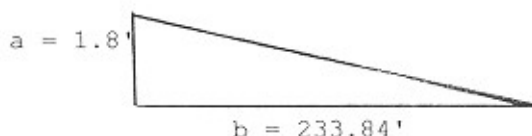   24" pipe = 2'   Place this figure on the net fill

line for each side. See sheet, figure C.

Step 4.   Place the rate of slope in the parentheses on the next
                 line (3) for the 3:1 slope. Multiply this times the net
                 fill for each side:
                      Left = 30.74' x 3 =92.22'
                      Right = 32.54' x 3 = 97.62'
                 Place this figure on the slope line for each side. This
                 is the length of pipe required for the point from the
                 shoulder break to the end of the pipe for each side. See
                 sheet, figure D.

Step 5.   Place the distance from the centerline to the shoulder on
                 the next line:
                      12' lane + 10' shoulder = 22'. This is the same for
                 each side. Add this to the slope distance computed in
                 Step 4.:
                      Left = 92.22' + 22.00' = 114.22'
                      Right = 97.62' + 22.00' = 119.62'
                 See sheet, figure E.

Step 6.   Add the 2 sides together for the total length:
                      114.22' + 119.62' = 233.84'
                 Check for an increase in length due to pipe fall:
                      530.2' inlet elev. - 528.4' outlet elev. = 1.8' fall.

                 Use $a^2 + b^2 = c^2$, where:

                 $a = 1.8'$
                 $b = 233.84'$

                 $(1.8)^2 + (233.84)^2 = c^2$

                 $3.24 + 54681.145 = c^2$

                 $54684.385 = c^2$
 $c = 233.85'$ No substantial increase

                 Round up to the next even foot and record in the total
                 column. Use 234', this is also the amount to order. See
                 sheet, figure F.

Skew pipes   For pipes on a skew figure the same as before and use the
                 computed length for the perpendicular length in the
                 following formula:
                      Length on skew = Perpendicular Length/cos skew angle

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Skew example   In the previous situation all is the same except the pipe is skewed 15 degrees to the right.

Plan View
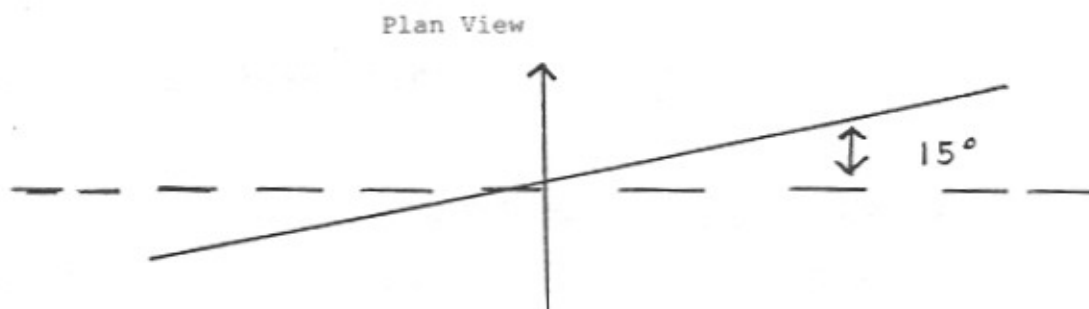
Using the previous information for the length and the above formula:

    233.85/cos 15 degrees = Length on skew
    233.85/ 0.965925826 = 242.10'
    Round to 242', This is the order length. See sheet, figure G.

Note   If riveted pipe is used, it must be ordered in even 2' lengths. Spiral crimped seam pipe can be ordered to the nearest 1' length.

Contract Number _____

Project Number _____

Structure No. _____ Station _____ Line _____

Plan Length _____ Calculated Length _____

_____ Profile Grade _____

_____ Shldr. Elev. _____

_____ Flow Line Elev. _____

_____ Gross Fill _____

_____ Deduct for Pipe _____

_____ Net Fill _____

_____ (____)Slope(____)_____

_____ L. to Shld. Dist. _____

_____ Total _____

_____ Skew Factor _____

_____ Total _____

Order _____ ft.

Connect to Str. No. _____

Inlet Type _____

Contract Number _____

Project Number _____

Structure No. _____ Station _____ Line _____

Plan Length _____ Calculated Length _____

LEFT

RIGH

_____ 563.15 _____ Profile Grade ____ 563.15 _____

_____ 562.94 _____ Shldr. Elev. ____ 562.94 _____

_____ Flow Line Elev. _____

_____ Gross Fill _____

_____ Deduct for Pipe _____

_____ Net Fill _____

_____ (____)Slope(____) _____

_____ L. to Shld. Dist. _____

_____ Total _____

_____ Skew Factor _____

_____ Total _____

Order _____ ft.

Connect to Str. No. _____

Inlet Type _____

Contract Number _____

Project Number _____

Structure No. _____ Station _____ Line _____

Plan Length_____ Calculated Length_____

LEFT _____563.15_____ Profile Grade _____563.15_____ R/

_____562.94_____ Shldr. Elev. _____562.94___

_____530.20_____ Flow Line Elev._____528.40___

_____32.74'_____ Gross Fill _____34.54'_____

_____ Deduct for Pipe_____

_____ Net Fill _____

_____ (___)Slope(___)_____

_____ L. to Shld. Dist._____

_____ Total _____

_____ Skew Factor _____

_____ Total _____

Order_____ft.

Connect to Str. No. _____

Inlet Type_____

Contract Number _____

Project Number _____

Structure No. _____ Station _____ Line _____

Plan Length _____ Calculated Length _____

LEFT

RIGH

563.15	Profile Grade	563.15
562.94	Shldr. Elev.	562.94
530.20	Flow Line Elev.	528.40
32.74	Gross Fill	34.54
2.00	Deduct for Pipe	2.00
30.74	Net Fill	32.54
	(___)Slope(___)	
	L. to Shld. Dist.	
	Total	
	Skew Factor	
	Total	

Order _____ ft.

Connect to Str. No. _____

Inlet Type _____

Contract Number _____

Project Number _____

Structure No. _____ Station _____ Line _____

Plan Length _____ Calculated Length _____

			RIGHT
LEFT	563.15	Profile Grade	563.15
	562.94	Shldr. Elev.	562.94
	530.20	Elow Line Elev.	528.40
	32.74'	Gross Fill	34.54'
	2.00'	Deduct for Pipe	2.00'
	30.74'	Net Fill	32.54'
	92.22'	(3)Slope(3)	97.62'
		₵ to Shld. Dist.	
		Total	
		Skew Factor	
		Total	

Order _____ ft.

Connect to Str. No. _____

Inlet Type _____

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Contract Number _____

Project Number _____

Structure No. _____ Station _____ Line _____

Plan Length _____ Calculated Length _____

LEFT

RIGHT

	563.15	Profile Grade	563.15
	562.94	Shldr. Elev.	562.94
	530.20	Blow Line Elev.	528.40
	32.74'	Gross Fill	34.54'
	2.00'	Deduct for Pipe	2.00'
	30.74'	Net Fill	32.54'
	92.22	(3)Slope(3)	97.62'
	22.00'	₵ to Shld. Dist.	22.00
	114.22'	Total	119.62
		Skew Factor	
		Total	

Order _____ ft.

Connect to Str. No. _____

Inlet Type _____

Contract Number _____

Project Number _____

Structure No. _____ Station _____ Line _____

Plan Length _____ Calculated Length _____

RIGH

LEFT			
563.15	' Profile Grade	563.15	
562.94	Shldr. Elev.	562.94	
530.20	Flow Line Elev.	528.40	
32.74'	Gross Fill	34.54'	
2.00'	Deduct for Pipe	2.00'	
30.74'	Net Fill	32.54'	
92.22'	(3)Slope(3)	97.62'	
22.00'	₵ L. to Shld. Dist.	22.00	
114.22'	Total	119.62'	
	Skew Factor		
233.84'	Total		

Order _2 3 4'_____ ft.

Connect to Str. No. _____

Inlet Type _____

Contract Number _____

Project Number _____

Structure No. _____ Station _____ Line _____

Plan Length _____ Calculated Length _____

			RIGHT
LEFT			
563.15	Profile Grade	563.15	
562.94	Shldr. Elev.	562.94	
530.20	Flow Line Elev.	528.40	
32.74'	Gross Fill	34.54'	
2.00'	Deduct for Pipe	2.00'	
30.74'	Net Fill	32.54'	
92.22'	(3)Slope(3)	97.62'	
22.00'	L. to Shld. Dist.	22.00'	
114.22'	Total	119.62'	
Mult= B= Cs 15°	Skew Factor		
242.10'	Total		

Order ___242___ ft.

Connect to Str. No. _____

Inlet Type _____